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Closed Circuit Current Monitoring

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Model: E65 - 745i / E66 - 745Li

Production Date: 11/2001 - E65, 03/2002 - E66

Objectives of The Module

After Completing this module, you will be able to:

- Explain what the Power Module uses to calculate the optimum charge voltage.
- Identify when the battery switch is left in the “OFF” position.
- Perform the Battery Replacement Registration after replacing a battery.
- Understand a normal Shut Down Protocol and identify a violation.
- Identify 2 “visuals” that indicate the vehicle is entering sleep mode.
- List the final Closed-Circuit Current draw on a “normal” vehicle.
- Explain what Special Tool #90 88 6 612 310 is used for and demonstrate it’s use.

Purpose of The System

This module describes the technical changes that have been made to the Power Module relevant to fault codes and diagnostic service procedures. You should be familiar with the basic operation covered in the E65 Complete Vehicle course (ST042). Additional information is now available for:

- Closed circuit current monitoring
- Check Control messages
- Battery replacement

The Power Module ensures that the battery charge level is maintained when the engine is running and when the vehicle is at rest. The Power Module is also responsible for maintaining the power supply (in the event of faults in the electrical system) to important vehicle systems by disconnecting lower priority circuits.

Power Module Functions

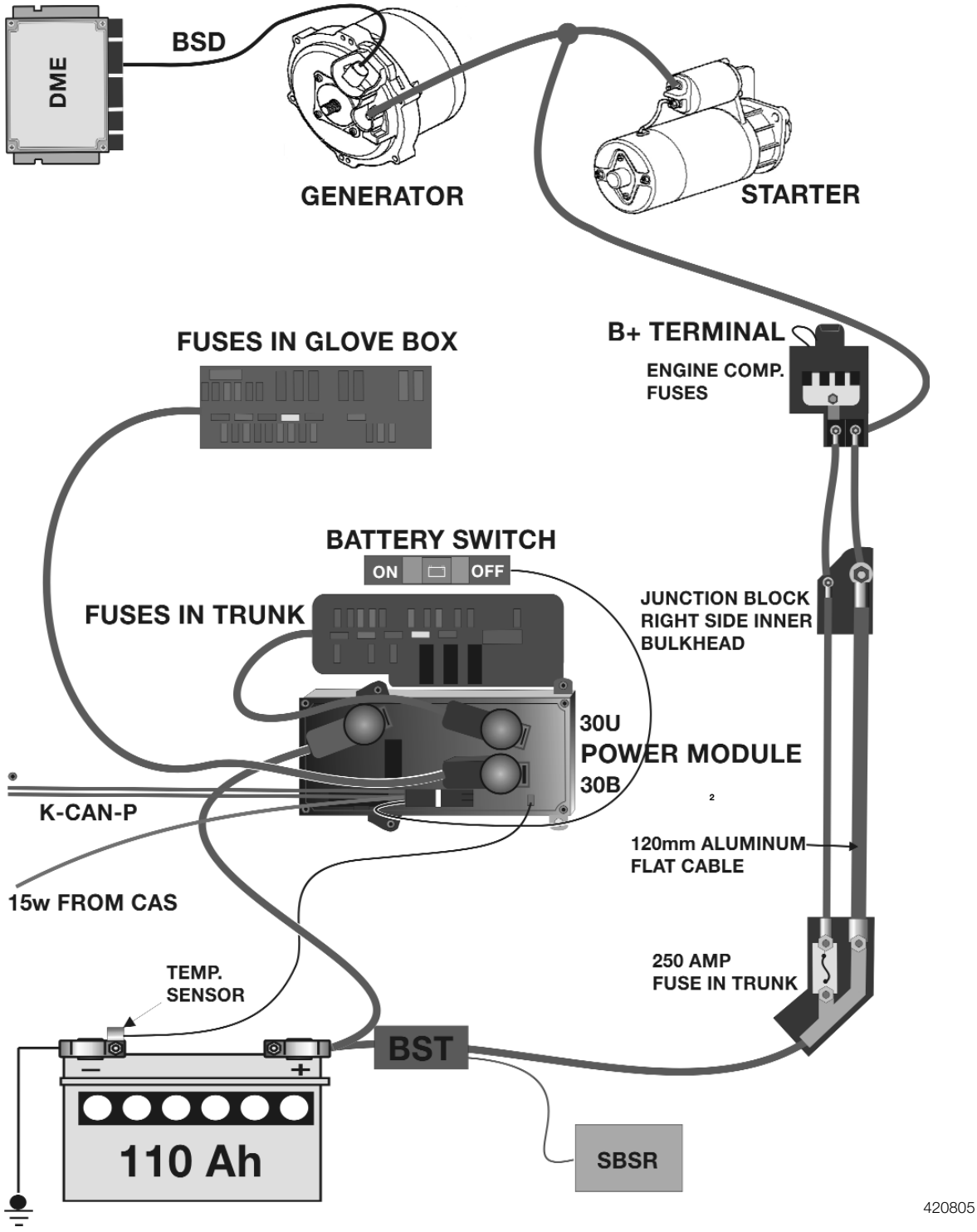
- Optimum charging.
- Load-circuit peak reduction.
- Shut-down of auxiliary consumer circuits in the event of low voltage.
- Closed circuit current monitoring.
- Distribution mode.
- Automatic electrical system isolation.
- Load cutout.
- Electronic fuses.
- Central battery voltage notification.
- Rear window defogger output.
- Interior lighting control.
- Trunk lid and fuel filler flap control.
- Data memory storage.
- Emergency-mode functions.
- Check Control messages.
- Diagnosis.

System Components

- Power Supply circuit
- Fuses
- Power Module
  - Electronic battery master switch
  - High-current sockets
  - Inputs
  - Outputs connected to electronic battery master switch
  - Outputs not connected to electronic battery master switch
  - Electronic control unit

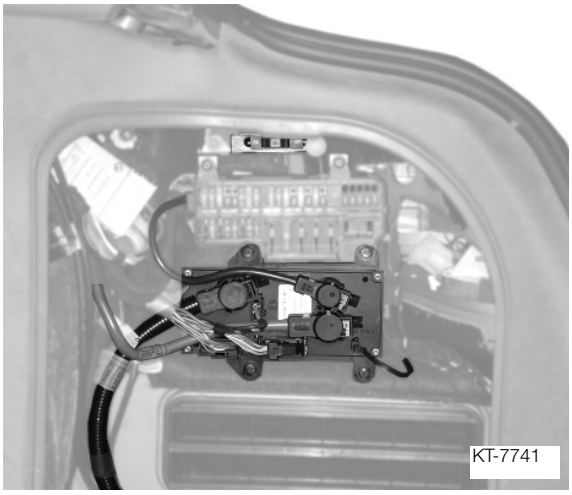
Power Supply Circuit

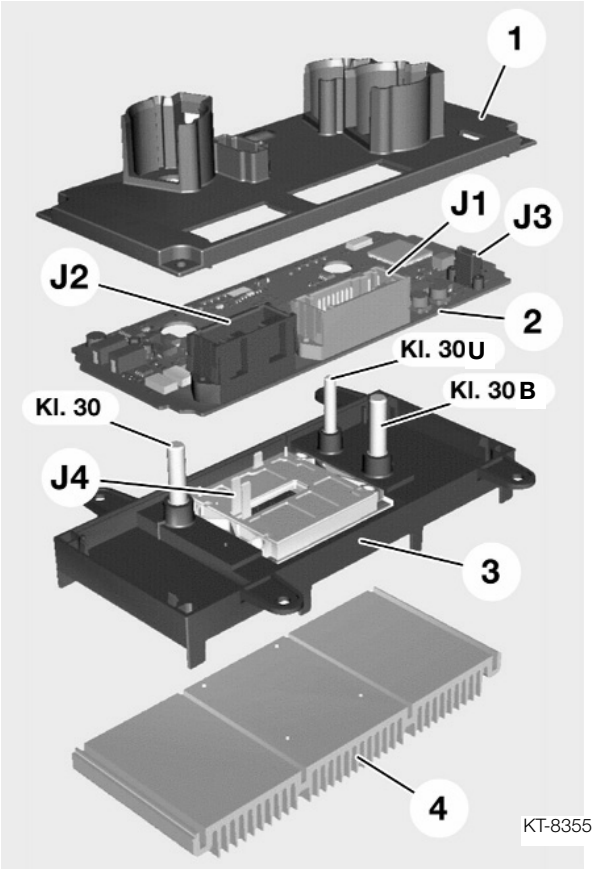
The power supply for the general electrical system is controlled by the Power Module. The high amperage fuses in the engine compartment, the alternator and the starter motor are connected directly to the battery and not supplied by the Power Module.



Power Module - Location and Construction

The Power Module on the E65 is located on the right-hand side of the luggage compartment.





1. Cover plate

2. Electronics

3. Electronic Battery Master switch

4. Heat sink

KL 30, KL 30B and KL 30U = High-Current Terminals

Electronic Battery Master Switch

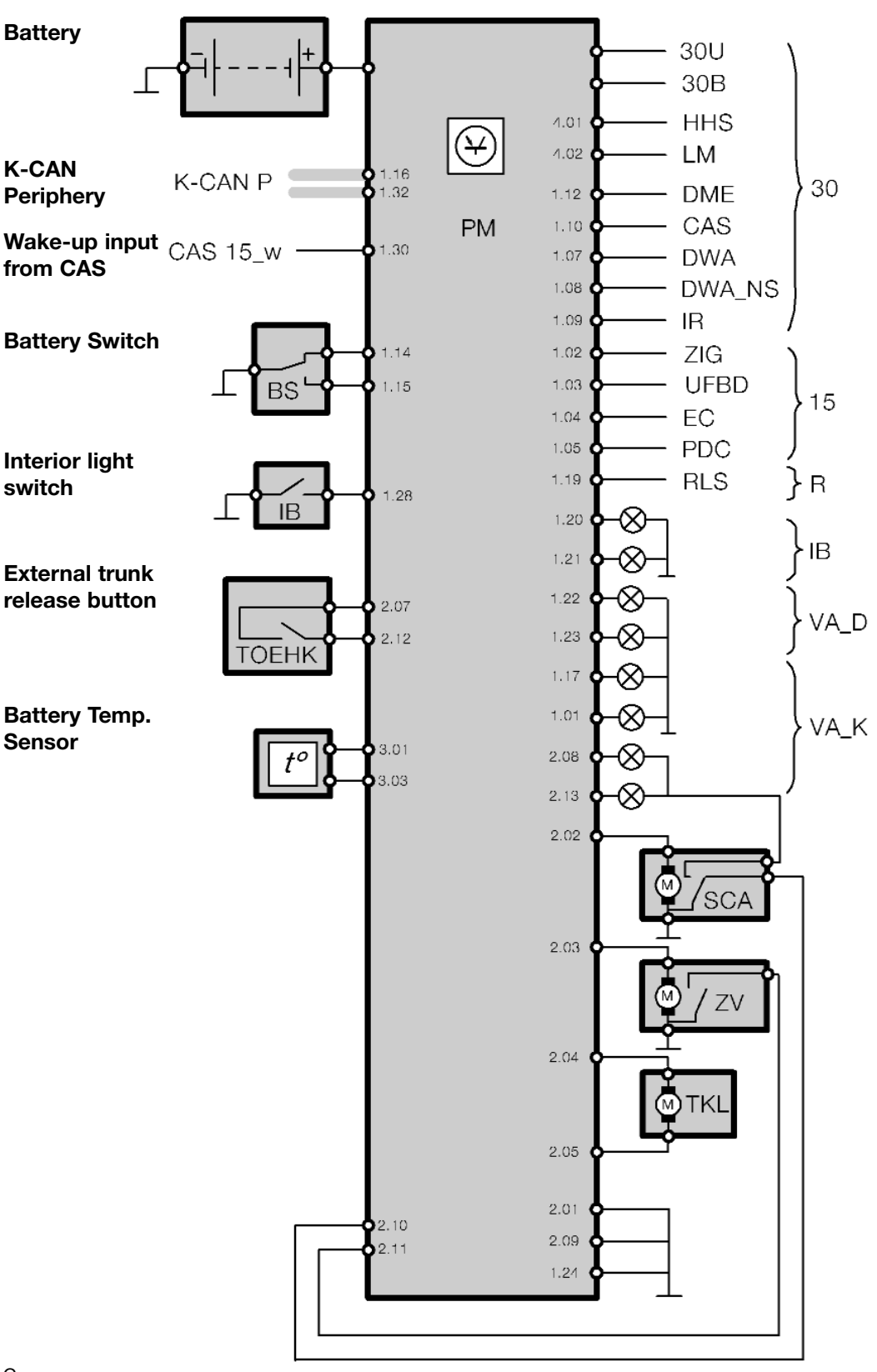
The electronic battery master switch is made up of 4 MOS-FET output stages (S Bat) and connects the input terminal 30 with the outputs KL 30U and KL 30B on the Power Module. The following functions are controlled by means of the Power Module according to the position of the battery switch:

- Storage mode
- Closed circuit current monitoring
- Electronic fuses
- Automatic electrical system isolation

High-Current Terminals (RADSOK®)

New high-current terminals are used in the E65/E66. The high-current terminals are on the input terminal 30 and the outputs terminal 30U and terminal 30B. These contacts are capable of carrying current peaks (short term) of 220 A.

Inputs/Outputs



Terminal 30 outputs

HHS=Rear window defogger.
LM=Lamp Module.
DME=ECU
CAS=Car Access System
DWA=Alarm C.U.
DWA NS=Sirene
IR=Not used in U.S.

Terminal 15 outputs

ZIG=Cig. lighter relay
UFBD=Universal remote control.
EC=Electrochromatic mirrors.
PDC=Park Distance Control.

Terminal R outputs

RLS=Rain/Light Sensor

(IB) Interior Lighting

(VA-D) Consumer Isolation Circuit/Roof

(VA-K) Consumer Isolation Circuit/Body

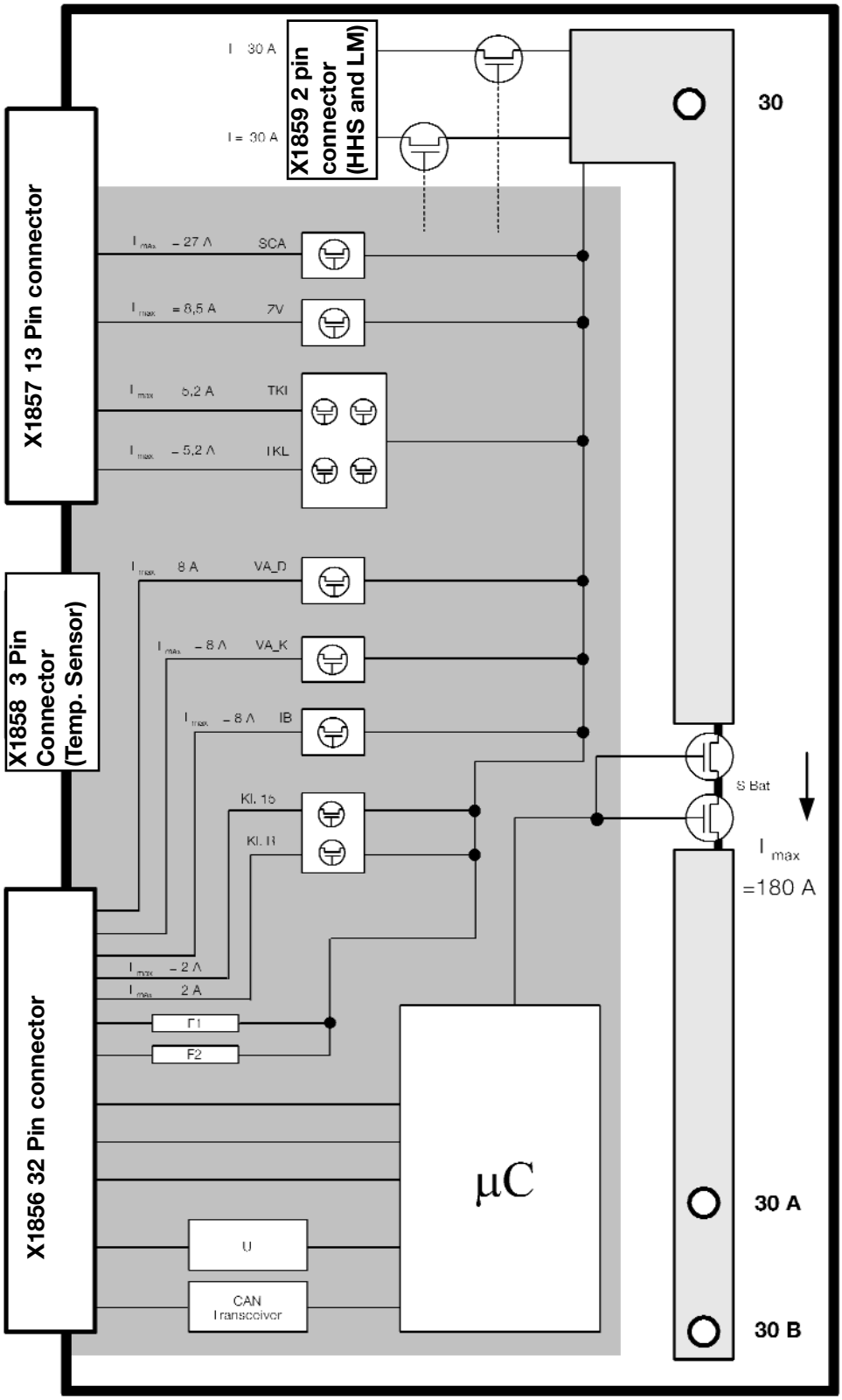
SCA
Soft Close Actuator (Trunk)

ZV
Central lock Actuator (trunk)

TKL
Central lock Actuator (Fuel door)

KT-8350

Detailed view of Power Module

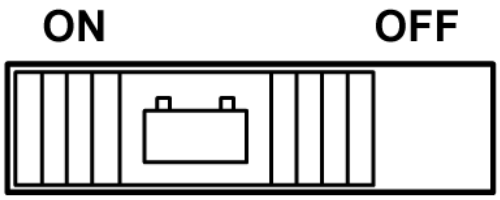


KT-8349

Inputs

Terminal 30
The battery positive terminal is connected directly to the load input of the Power Module.

Battery Switch
The battery switch (BS) offers the vehicle owner and the service department the choice between the settings ON ("closed circuit current monitoring") and OFF ("storage mode"). It is located above the PM on the right hand side of the luggage compartment.



KT-8288

Interior Lighting Button
This controls the interior lighting and is located on the front interior lighting unit. The possible settings are "Automatic control", "On", "Off" and “Workshop mode” (hold for 3 seconds).

Exterior Trunk Lid Release Button (TOEHK)
This button is a direct input to the Power Module. The trunk lid is released by means of the button on the outside of the trunk lid.

Trunk Lock Actuator Switch
The switch in the trunk lock actuator is used to inform the Power Module as to the position of the lock actuator and to synchronize the SCA. it also controls the luggage compartment lighting, the monitoring of the alarm system and the trunk lid warning light.

SCA Contact
This input is used to signal the PM that the SCA has rotated 180^0 (used to switch off the electric motor).

15_w (wake-up)
This is a redundant signal from the Car Access System which wakes up the Power Module.

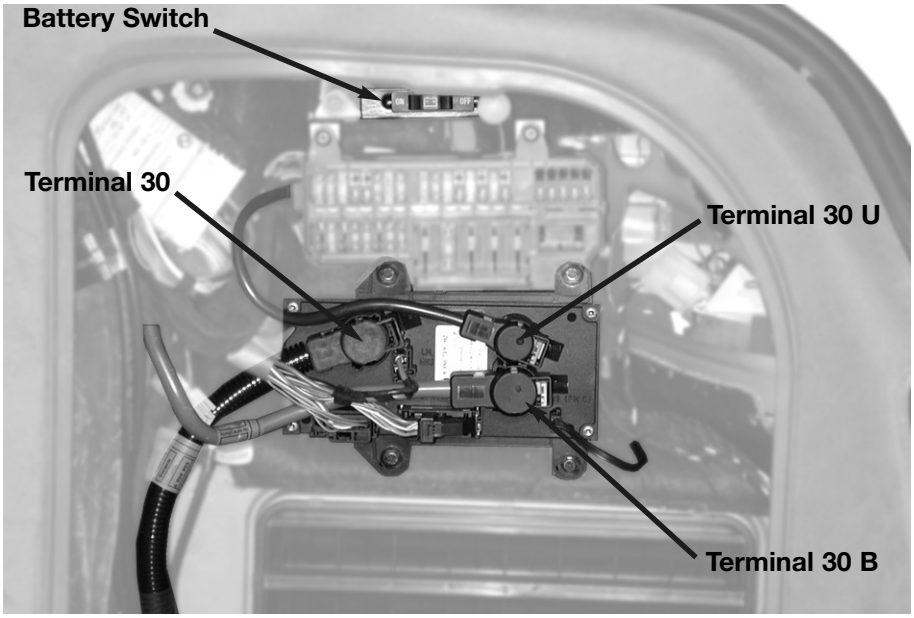
Battery Temperature Sensor
Measures the temperature directly on the battery negative terminal. This information is used for the "optimum charging" function. The measuring range is -25°C to +75°C.

K-CAN Periphery
Enables communication with the vehicle network.

Outputs Connected to Electronic Battery Master Switch

Terminal 30U
Supplies the fuse box in the luggage compartment.

Terminal 30B
Supplies the fuse box in the glove compartment.



Outputs Not Connected to Electronic Battery Master Switch
The following outputs are supplied by the PM separately from the Electronic Battery Master Switch.

- Rear window heater (HHS)
- Light Module (LM)
- Car Access System (CAS)
- DME
- Alarm system (DWA)
- Emergency power siren (SINE)
- Cigarette lighter (ZIG)
- Electrochromatic mirrors (EC)
- Park Distance Control (PDC)
- Rain/light sensor (RLS)
- Interior lighting (IB)
- Central locking trunk lid drive (ZV)
- Central locking, fuel filler flap (ZV)
- Trunk lid Soft Close Motor (SCA)

The advantages of this arrangement are:

- The exterior lighting can remain on (for safety reasons) even if the Electronic Battery Master switch is off.
- The alarm system is always armed.
- No additional fuses and wiring for actuators in nearby locations.

Fuses
The outputs for the rear window heater, KL R and KL 15, are not protected by conventional fuses. They are supplied via a power transistor (MOS-FET) in the Power Module.

By measuring the current and comparing it with stored threshold levels, the Power Module can detect a short circuit and disconnect the circuit if needed. The outputs for CAS, DWA and DME are protected by internal electronic fuses.

Shut Down Protocol

Shut-Down of Consumer Circuits (Sleep mode)

To prevent battery discharge by consumer items mistakingly left on, the interior lighting circuit (IB) and consumer circuits-roof zone (VA-D) *are shut off 16 minutes after KL R is switched off.*

The consumer circuit-body (VA-K) remains on longer for the cigarette lighter relay, glovebox lighting, luggage compartment light and the telephone (recharging if plugged in). The VA-K *is shut off 60 minutes after KL R is switched off.*

Shut-Down of Auxiliary Consumers

In order to ensure that the car is capable of starting, the charge level (SoC-State of Charge) of the battery is monitored when the vehicle is at rest. The minimum battery SoC required to ensure that the car can be started again is a calculated value.

The calculation takes into account the:

- Battery temperature measured over last few days
- Engine type
- Capacity of the battery fitted (110Ah for the 745i).

The SoC calculation is displayed as a percentage of battery capacity (a fully charged battery is considered 80%). If the charge level of the battery gets close to that calculated minimum level as a result of the operation of an auxiliary consumer unit, the Power Module instructs that circuit to switch off.

Auxiliary consumer circuits are items such as the Control Display, DWA, LM, EGS and IHKA (rest function). There are two modes of operation when shutting down auxiliary consumer circuits: auxiliary consumers with KL R “ON” and auxiliary consumer with ignition off (KL 0).

Closed-Circuit Current Monitoring - Normal Sleep Mode

- When the ignition is switched “OFF” (KL 0), the Busses go to sleep in 2 minutes.

- After 16 minutes, the Power Module sends a signal for the consumer circuits-roof zone (VA-D) shut-down and briefly wakes the Busses.

- VA-D is switched off and the Busses resume sleep mode.

- After 60 minutes, the consumer circuit-body (VA-K) is switched off.

The Power Module now assumes closed-circuit current monitoring mode:

- Cyclic ***voltage*** measurement every 5 seconds, cyclic ***current*** measurement every 60 seconds.

  Note: If an operation is performed on the vehicle before 60 minutes has elapsed (central locking, trunk opened), the timer starts again from the beginning.

- Once the 60 minute period has ended, the closed-circuit current is approximately 30 mA (max. 50 mA).

- If the closed-circuit current exceeds 80 mA, the Power Module will monitor a 5 minute “waiting period” allowing the vehicle an opportunity to resume the normal 30 mA closed-circuit current.

- If the excessive current remains after the 5 minute waiting period, a fault code with the current value is stored. The Power Module issues the "Shutdown Counter" message and after 90 seconds, the vehicle's electrical system is shut down (briefly isolated) by the Electronic Battery Master Switch.

  A second attempt is made and if excessive current draw is still present, the Shutdown Counter functions again after 90 seconds to isolate the electrical system.

The Electronic Battery Master Switch is reconnected under the following conditions:

- Change ignition from “OFF” to KL R or KL 15
- Toggling of the Battery Switch (switching back and forth twice within 2 seconds)
- KL 15 wake-up line (from CAS)
- External charge detection (> 13.2 V at the Power Module)
- CAN message relating to activated, legally required electric loads (hazard warning lights)

When the signal “15w” from the CAS is detected, the Electronic Battery Master Switch is closed and the following Check Control message is displayed:

Check Control Message displayed in KOMBI	Message displayed in Control Display	Cause
High standby current! 	High standby current! Vehicle electrical accessories are drawing excessive passive-state current. Battery has been disconnected Please contact your BMW center.	Excessive closed-circuit current draw

Closed-circuit current monitoring is automatically cancelled by a message from the Lamp Module that the hazard warning lights are active.

When KL R is switched off, current monitoring is also immediately activated. Normal current load on the vehicle drops in stages according to the vehicle programming for sleep mode (see chart on the following page).

If the monitored current is > 120 amps (even as a random spike) , the interior lighting, roof area consumers and body zone consumer circuits are immediately switched off.

Reasons for Electronic Battery Master Switch Disconnection

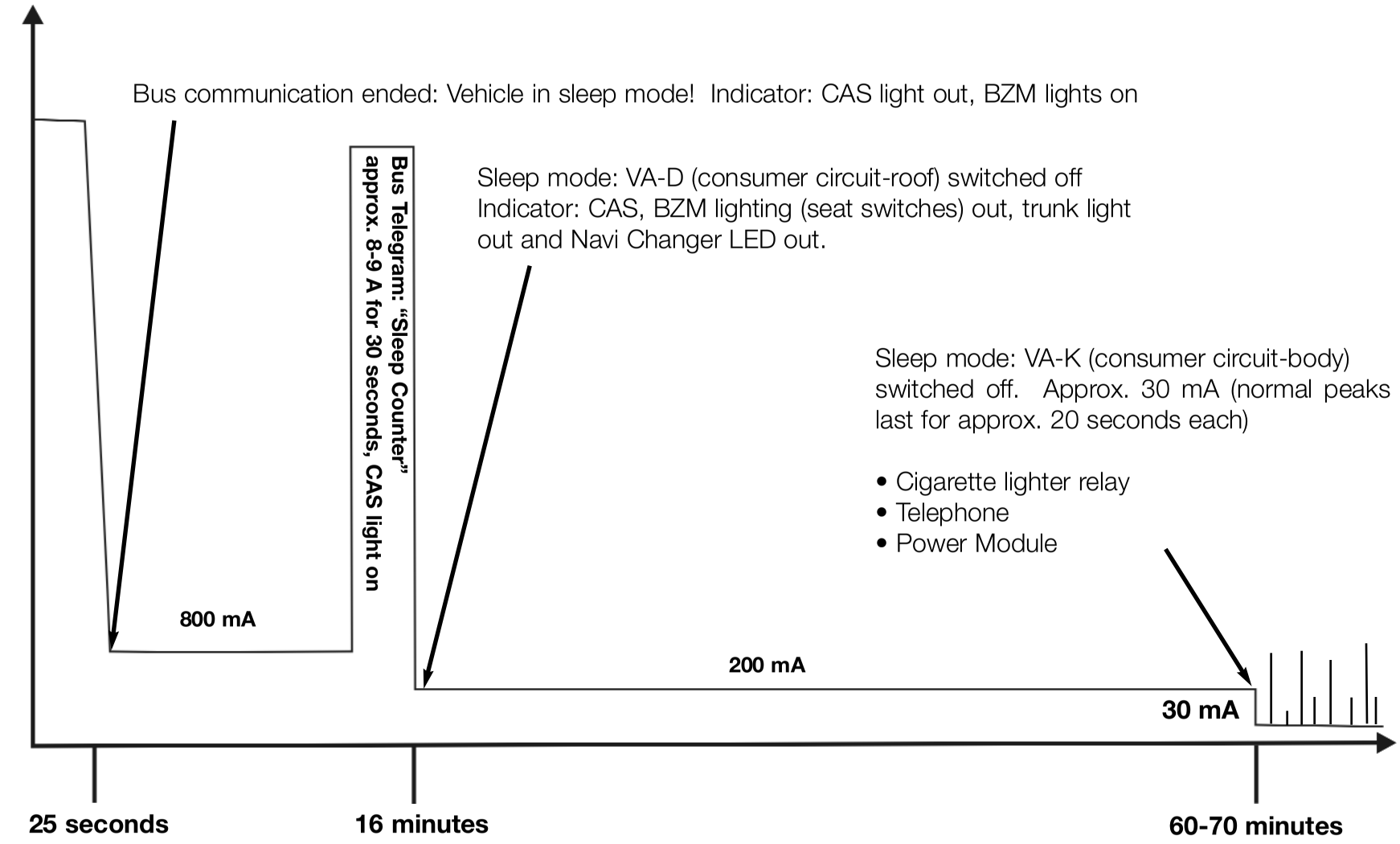
The reason for battery disconnection is stored together with the fault code in the Power Module fault memory. Several examples that may be stored are:

- The battery was disconnected because a current > 120 Amps was measured after switching off KL R.

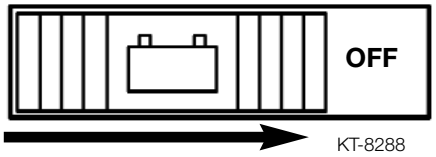
  Note: The current threshold was increased from 35 Amps to 120 Amps because all four power window motors can be operated simultaneously up to the end stop.

- The battery was disconnected because an excessively high vehicle closed-circuit current was measured.
- The battery was disconnected after a 3 week parking period.
- The battery was disconnected by activation of Storage Mode with the Battery Switch.
- The battery was disconnected because the battery capacity (SoC) dropped below the start limit with KL R switched on and KL 15 switched off.
- The battery was disconnected because a short-circuit in KL 30 was detected.
- The battery was disconnected by a DISplus/GT1 diagnostic command.

Closed-Circuit Current Monitoring and Vehicle Sleep Mode



Storage Mode



By switching “OFF” the battery switch, the Power Module goes into Storage Mode 30 minutes after terminal R switches off.

Before disconnecting, the PM sends out the "Shutdown" signal. After a further 90 seconds the shut down is completed. If the ignition switch is turned to KL R or KL15, a Check Control message is issued which informs the driver that the vehicle is in Storage Mode.

The following CC message appears:

Check Control Message displayed in KOMBI	Message displayed in Control Display	Cause
Battery switch OFF ! 	Battery switch OFF! Re-set battery switch in luggage compartment to ON, refer to owners manual.	Battery switch left in OFF position.

When the signal “15w” or change-over of the battery switch to "closed-circuit current monitoring" is detected, the Electronic Battery Master Switch is closed.

The vehicle can still be started and driven in storage mode. All systems remain functional. The CC message remains active.

When KL R “Off" is active, disconnection is carried out after 30 minutes (as explained above).

Note: If the battery switch is detected as defective, closed-circuit current monitoring will be activated.

If no function of any kind is activated over a period of 3 weeks, the battery is disconnected from the vehicle's electrical system to prevent battery discharge. This function is independent of the position of the battery switch.

Electronic Fuse

If a short circuit current of over 250 A is detected, the Electronic Battery Master Switch is opened. When the wake-up signal “15w” from the CAS is detected, then an attempt is made to close the Electronic Battery Master Switch again.

This procedure is repeated continually until the short circuit has been eliminated.

Check Control Messages

The following are Power Module relevant messages:

Check Control Message displayed in KOMBI	Message displayed in Control Display	Cause
Battery Switch OFF! 	Battery switch OFF! Re-set battery switch in luggage compartment to ON, refer to owners manual.	Battery switch left in OFF position.
High standby current! 	High standby current! Vehicle electrical accessories are drawing excessive passive-state current. Battery has been disconnected Please contact your BMW center.	Excessive closed-circuit current draw.
Recharge Battery! 	Recharge battery! Battery heavily discharged. Charge by driving for longer period or by using external charger. Battery will be disconnected soon.	Battery discharged
Power Module! drive moderately 	Power module in emergency ! operating mode. Electrical power supply limited. Please contact the nearest BMW center.	Power module in emergency mode
Power Module failure! Automatic monitoring of battery charge level failure. 	Power module failure! signal missing over Please contact the nearest BMW center.	Power module alive bus line.

Notes:

Workshop Hints

Closed Circuit Current Monitoring For The E65/E66 Electrical System

In the event that an E65/E66 vehicle has a battery draw and/or the Power Module has faults stored in memory relative to closed circuit current monitoring, the following is provided to assist you in diagnosis.

Increased closed-circuit currents may occur permanently or occur intermittently, and cause the battery to discharge prematurely. The increase in closed circuit current may be caused by a faulty control module, or by the installation of a non-approved accessory.

In a situation where a vehicle has compalints due to a discharged battery, for diagnostic purposes it is important not to disconnect the battery. This is because a control module will be reset if the battery is disconnected. Following a reset, the faulty control module may start functioning correctly again, making accurate diagnosis impossible.

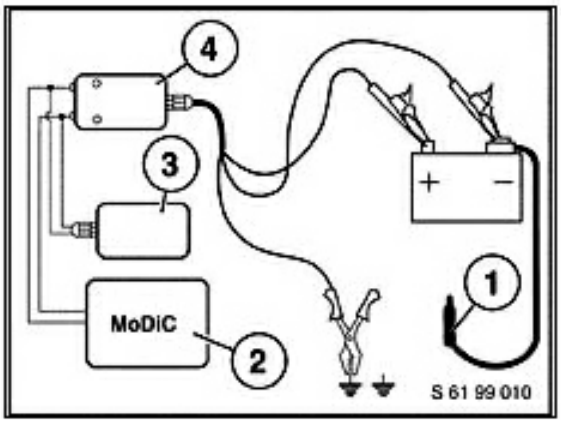
To correctly measure closed-circuit current, measurement adapter Special Tool *P/N 90 88 6 612 300* should be used. This tool provides a bridge to ground, before the negative battery terminal is disconnected, and this prevents the control modules from being reset.

The additional use of MoDiC adapter Special Tool *P/N 90 88 6 612 310* provides a method for current measurements over an extended period of time.

This procedure should be followed after you have reviewed the Power Module “Principle of Operation” in the beginning of this module.

Tools Required:

- 50 amp inductive probe for DISplus or MFK1 for the MoDIC/GT1.
- BMW closed circuit current measuring tool # 61 2 300 (4. in diagram).
- Digital Multimeter capable of measuring up to 15 Amps.
- MoDIC adapter # 61 2 310 for recording draws up to 72 hours (3. in diagram).



Preconditions:

- First, *read and understand SIB # 61 08 00*

- Charge the vehicle battery with a BMW recommended (Deutronic) battery charger to obtain a minimum of 12.6 Volts. The battery charger must be disconnected prior to any draw testing.

- Vehicle charging system must be operating correctly.

- Ceck for faults and correct any faults that are present.

- Have a copy of the bus chart ready for reference. Understand the basics in order to "Divide and Conquer" the bus network.

- Review the power supply wiring diagram to understand the three (3) separate routes that the B+ potential can travel. The B+ lead that feeds the IVM/ECM, starter and generator. This lead has a junction in the luggage compartment and supplies the aluminum ribbon cable to the front of the vehicle.

  The second is the feed from the Power Module 30 B to the front fuse panel in the glove box. Moving the current probe to each individual cable will isolate which circuit has the current draw(s).

- Review the Vehicle Sleep Mode shut down protocol chart (page 13) to assist with comparisons when diagnosing a faulted vehicle.

Please Review the Following General Observations:

1. After swithcing the ignition "OFF", the CAS light remains "ON" for approximately 2 minutes. When the CAS LED goes out, this indicates that the Bus network is sleeping. At this time the current measurement should not be > 800 mA (.8 A).

2. After approximately 16 minutes the CAS led illuminates for approximately 30 seconds (Bus network is awake). After the CAS LED goes out (Bus network is sleeping), the BZM seat switch lights (left and right) will turn off. At this time the Power Module circuit VA-D roof consumers shut down (hint - leave a map light on as a visual). The current draw is approximately 200 mA (.2 A) at this time.

3. The remaining time until the vehicle is in "sleep mode" will occur in approximately 44 minutes (vehicle dependent). The total time for sleep mode could take up to 70 minutes.

4. The final closed circuit current draw should be approximately 30 mA (.030 A) or less (normal peaks last for approx. 20 seconds each). These normal peaks are a result of the Instrument Cluster performimg a temperature status check (deminishes in frequency as time goes on).

5. Always allow the vehicle to go into the sleep mode naturally. Do not use the DISplus/GT1 test module to expedite shut down on the initial diagnosis. This test module can be used after the conformation of failure has occurred and additional testing is required. This will help in speeding up the subsequent diagnosis.

Closed Circuit Current Monitoring Procedure:

The following instructions can be supplemented with the HI document in DIS under Power supply Diagnostic Test Plan, entitled ***"Procedure in event of closed circuit current faults".*** There are examples of closed-circuit current violations with additional diagnostic hints.

1. With the DISplus/GT1, interrogate all control modules with a short test. Correct all faults before proceding with closed circuit diagnosis. This includes reviewing diagnostic queries for the Power Module to analyze reasons for battery disconnects, battery SOC, battery history and basic charging operation.

2. Disconnect battery charger from the vehicle (remove clamps).

3. Open the trunk lid and secure the latch mechanism (as if the trunk lid was closed).

4. Open hood and lift up on the hood pin switch (service position).

5. To prepare for fuse access, open the glove box door and disable the glovebox light. This will avoid awakening the Power Module later.

6. Hook up current monitoring tools following this progression:

   If using the DISplus:
   - 50 amp inductive clamp around the B- cable from the battery to chassis ground. Access the BMW Test system ***"Multimeter screen"***, and select the ***"Current 50A"*** setting and ***"MIN/MAX"***.

   Prefered - MoDIC/GT1 (when function is available on GT1)
   - 50 amp inductive clamp around the B- cable from the battery to chassis ground.

   - MFK1 connected to Special Tools # 61 2 300 and # 61 2 310 (as shown on page 16). Follow MoDIC setup instructions per SIB # 61 08 00 (do not plug into MoDIC yet, just have connections ready), ***do not disconnect the chassis ground at this time.*** This tool can only handle a current of 10 amps or less and will fail until the vehicle current is safely below this value.

7. Shut off ignition “KL 0”, remove the remote key from vehicle. Open both front doors and secure rotatory latch (as if the doors were closed), *Use a suitable tool and not your finger! Be careful not to catch your fingers in the latch, the vehicle may be equipped with Soft Close Automatic (SCA).* Activate the remote locking “twice” (to disable the FIS sensor) and begin to watch for Bus power down.

8. After the CAS LED goes out (approx. 2 minutes), the current draw should not be > 800 mA. The BZM lights will remain on.

9. After approximately 16 minutes, the CAS LED will illuminate. The current draw will spike to approximately 8 - 9 A for 30 seconds. Then the CAS and BZM lights go out and the current draw will be approximately 200 mA for 60 -70 minutes. *Unplug the 50 amp clamp lead from the MoDIC and plug in the MFK1 lead, it is now safe to remove the chassis ground and the draw trace will begin if the MoDIC/GT1 is used.*

   At the 60 -70 minute point (sleep mode), if the closed-circuit current draw is > 30 mA, normal procedures of pulling fuses and disconnecting components will be necessary (as outlined below). Remember to divide and conquer the circuits with the help of the ETM.

If the closed-circuit current draw remains higher than 30 mA after 60 minutes or never drops down to less than 30 mA proceed as follows (the MoDIC/GT1- when function is available on GT1, *must be used at this point to establish a draw trace):*

10. Remove Fuse 5 from the front fuse box behind the glove compartment (Fuse 5 also powers the BZM, the seat switch lights will go out). Wait 2 minutes (allows CAS to reset) and recheck draw.

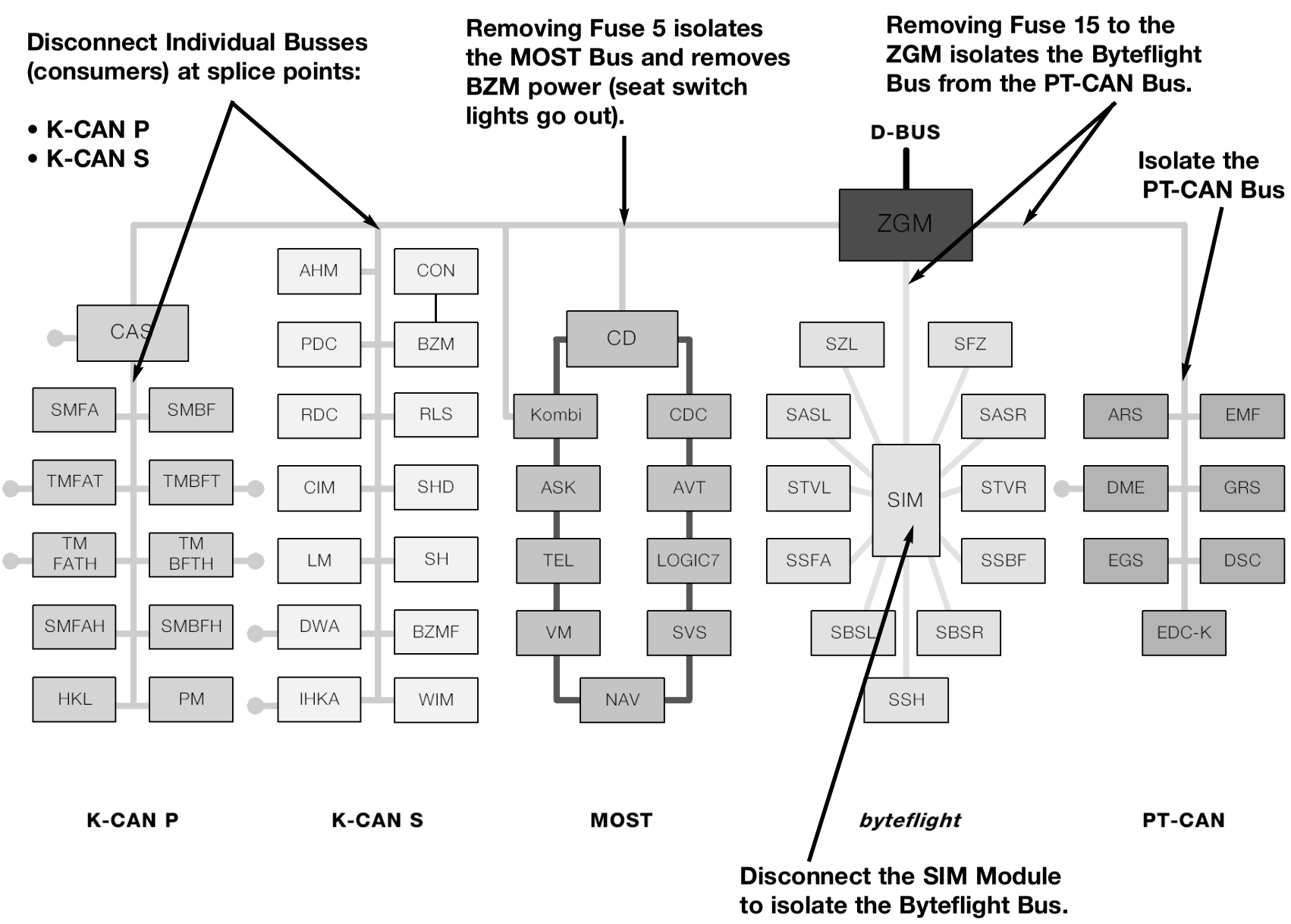
    If draw drops down to below 30 ma reinstall Fuse 5 and disconnect 1 MOST bus consumer at a time (Control Display last - it is the gateway) and install optic jumper (made from parts, available in EPC) wait 2 minutes between each disconnection (allows CAS to reset).

11. If draw is still present after Fuse 5 removal, remove Fuse 15 to ZGM from front fuse box, this isolates the Byteflight Bus from PT-CAN Bus.

    If draw drops down, then disconnect SIM module behind glove box and reinstall Fuse 15. If draw drops after SIM removal then draw is from Byteflight and isolate which Byteflight module is causing draw. If draw does not drop after SIM removal, the draw is coming from PT-CAN bus. Disconnect each PT-CAN Bus module until draw is gone.

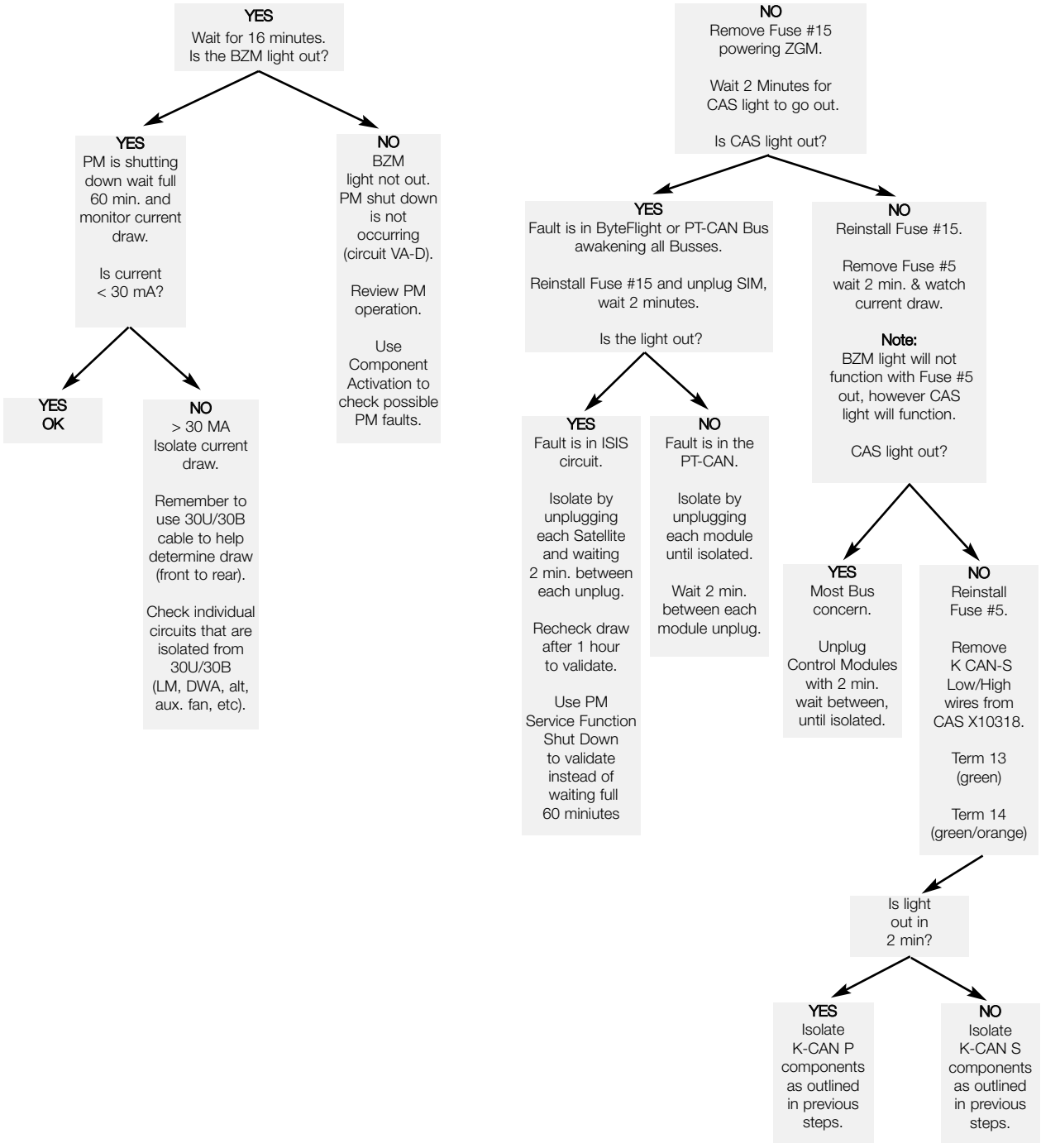
12. If removing Fuse 5 and or Fuse 15 do not drop draw below 30 mA, then draw is from K-CAN S and or K-CAN P modules. Disconnect one CAN consumer at a time until draw is gone.

Note: Please refer to Bus Chart on page 20.


Disconnect Individual Busses (consumers) at splice points:
• K-CAN P
• K-CAN S
Removing Fuse 5 isolates the MOST Bus and removes BZM power (seat switch lights go out).
Removing Fuse 15 to the ZGM isolates the Byteflight Bus from the PT-CAN Bus.
Isolate the PT-CAN Bus
D-BUS
ZGM
CAS
SMFA
SMBF
TMFAT
TMBFT
TM FATH
TM BFTH
SMFAH
SMBFH
HKL
PM
AHM
PDC
RDC
CIM
LM
DWA
IHKA
CON
BZM
RLS
SHD
SH
BZMF
WIM
CD
Kombi
CDC
ASK
AVT
TEL
LOGIC7
VM
SVS
NAV
SZL
SFZ
SASL
SASR
STVL
STVR
SIM
SSFA
SSBF
SBSL
SBSR
SSH
ARS
EMF
DME
GRS
EGS
DSC
EDC-K
K-CAN P
K-CAN S
MOST
byteflight
PT-CAN
Disconnect the SIM Module to isolate the Byteflight Bus.

Closed Circuit Current Monitoring Flow Chart

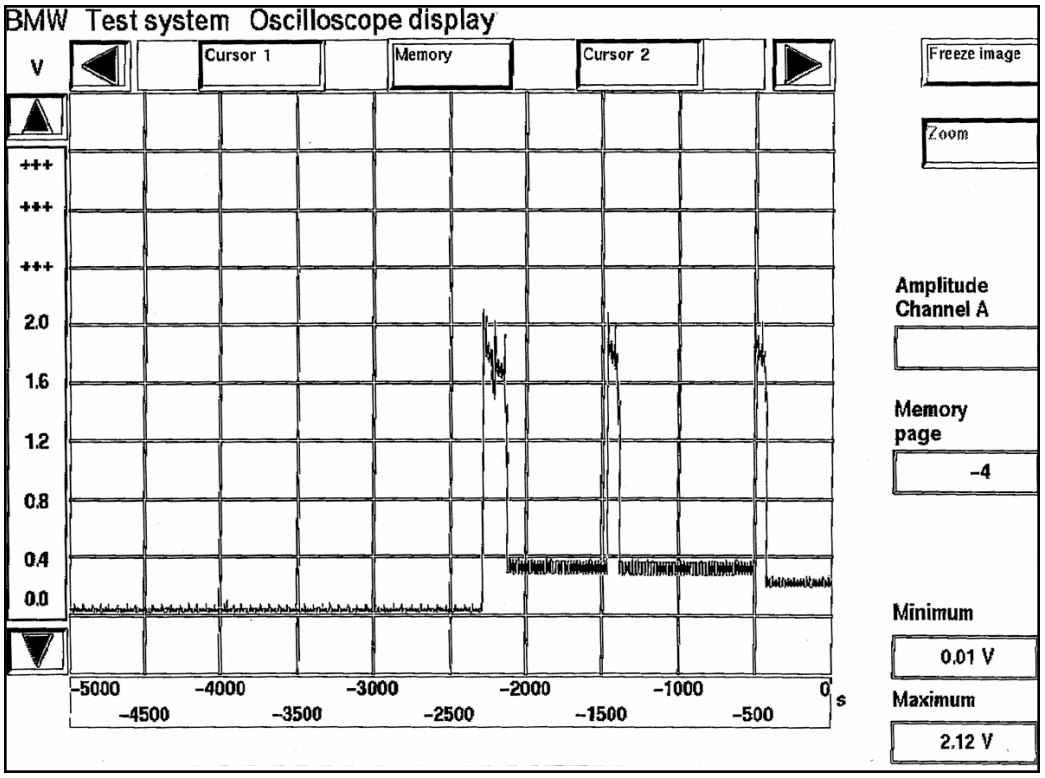
Key Off = KL”0”, Wait 2 min. is the CAS LED Out?



Sleep Mode with PT-CAN Bus Consumer (example)

When the closed-circuit current draw remains higher than 30 mA after 60 minutes or never drops down < 30 mA, the MoDIC/GT1 (when function is available on GT1) used at this point establishes a draw trace.

In this example, a consumer stays awake after the 60 -70 minutes. From the peaks you can observe that the closed-circuit current draw is not normal.



By removing Fuse #15 to ZGM (in front fuse box), the Byteflight and PT-CAN Bus circuits are isolated and the closed-circuit current draw decreases to a normal value.

After disconnecting SIM module and reinstalling fuse #15, the draw still exists indicating that it is from PT-CAN bus.

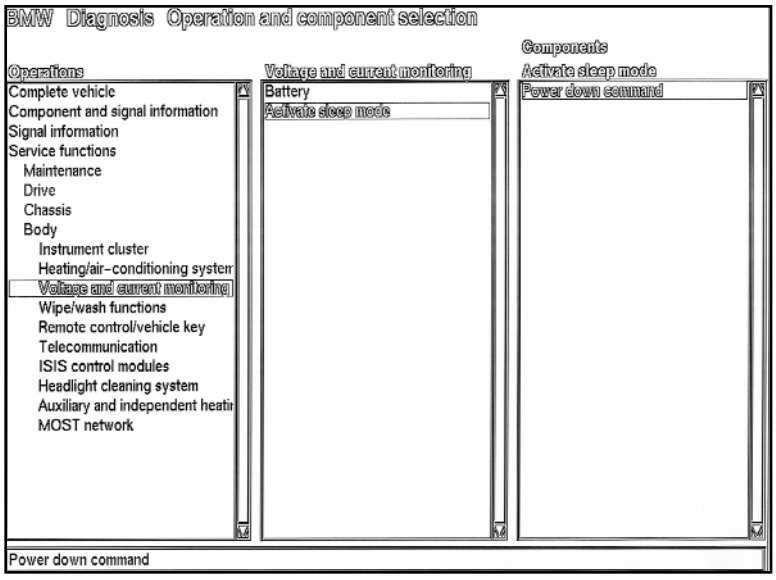
By disconnecting each PT-CAN Bus module (one at a time), the draw decreased after the Electro-mechanical Parking Brake Control Module (EMF) was unplugged. This component was staying awake and in addition, awoke the entire Bus network.

Diagnosing the Power Module with the DISplus/GT1

After the initial power down protocol in which the vehicle enters “sleep mode” naturally and excessive closed-circuit current draws are present, the DISplus/GT1 can be used to expedite sleep mode for further diagnosis.

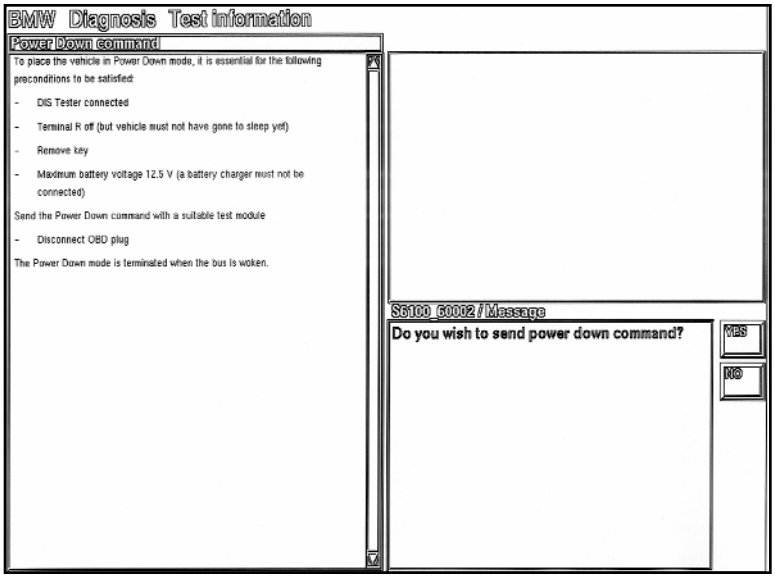
This procedure is found under: *Service Functions - Body - Voltage and current monitoring*.

- Select <Activate sleep mode>, <Power down command> and <Test Plan>.
- Highlight the Test Module and press the green <Arrow> to the right.



The following preconditions must be followed for a successful Power Down:

- DISplus/GT1 connected
- Battery Switch set to “ON”
- KLR “OFF”, but vehicle must not have gone to sleep yet
- Remove key
- Battery voltage must be at least 12.5 V and battery charger must be disconnected from vehicle
- This screen prompts you to select <Yes> to send the Power Down command.



Note: After the Power Down command is sent, disconnect the OBD diagnostic connector. The Power Down mode is terminated when a Bus is woken.

The inputs/outputs that are part of the Power Module can be diagnosed by Test Modules or status check by the Control Unit Functions of the Diagnosis Program. The outputs can be activated by Component Activation and the power consumption displayed.

All electronic fuses and the Electronic Battery Master Switch are monitored for short circuits/circuit breaks. In the event of a fault, an entry is made in the Power Module fault memory and if appropriate, a Check Control message is initiated.

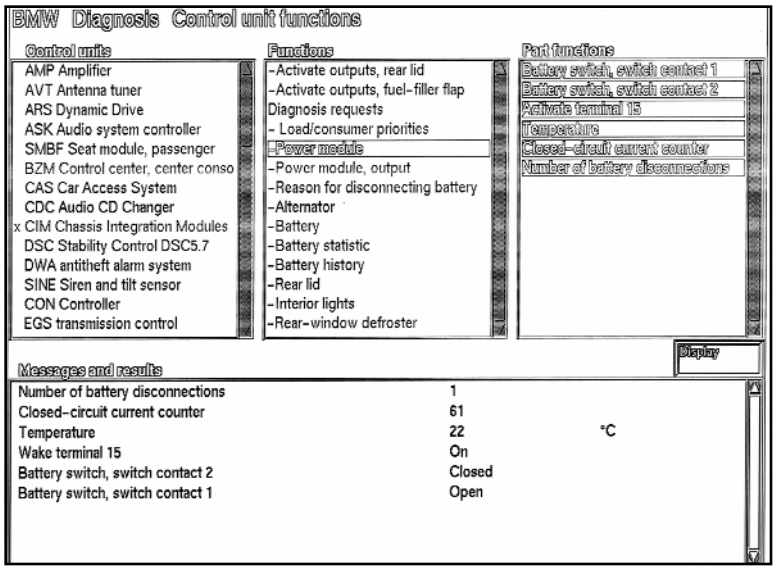
The “Status” of the Power Module and monitored circuits/components can prove to be very helpful in diagnosing faults and provide an overall state of vehicle “electrical power management”.

- From the DISplus/GT1 main menu (after a short test was completed), select <Control unit functions>.

- Select <Power Module> and highlight Part Functions of the status to be displayed.

Some Power Module status examples to consider are:

- Number of battery disconnections
- Closed-circuit current counter
- Temperature
- Wake terminal 15
- Battery switch, switch contact 2
- Battery switch, switch contact 1

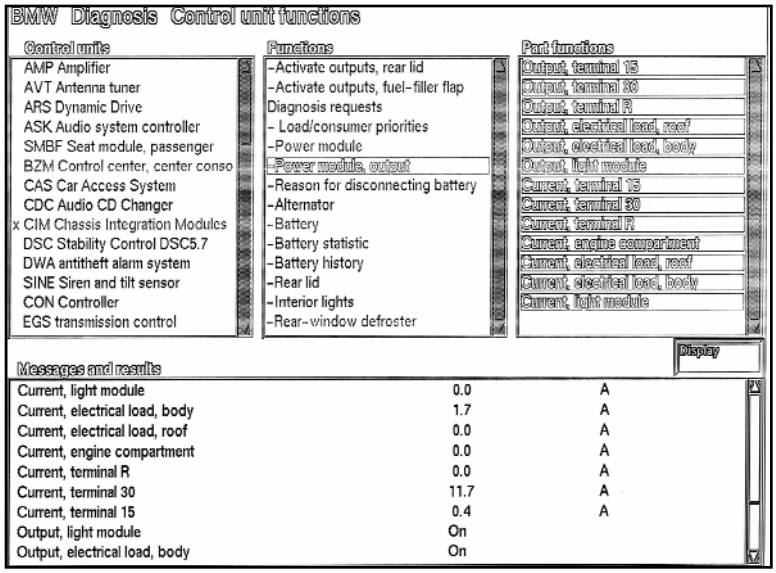


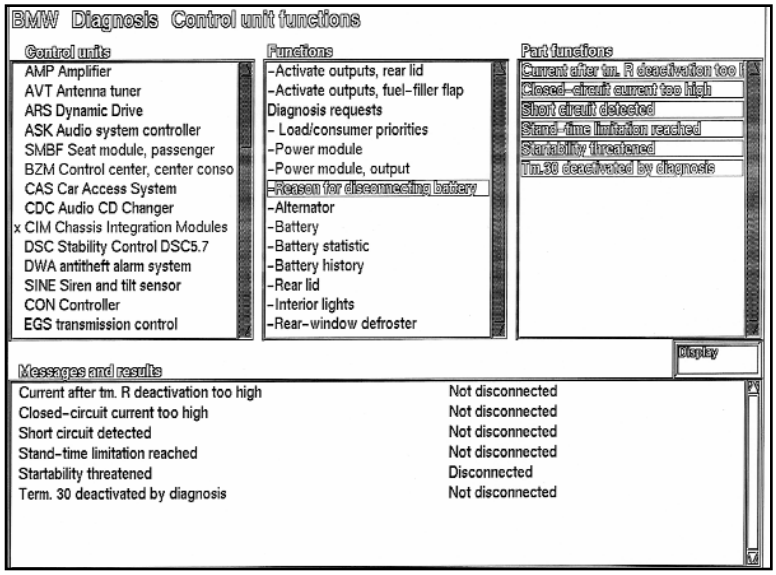
Notes:

- By selecting <**Power Module, output**>, output loads and con sumers with the amperage values are displayed.

This includes the electrical load for the roof and body zone previously mentioned. ***These functions can be activated/deactivated found in: "Activate outputs, electrical loads".***

This provides you with information about what circuit of the Power Module is experiencing current draw, normal or excessive.



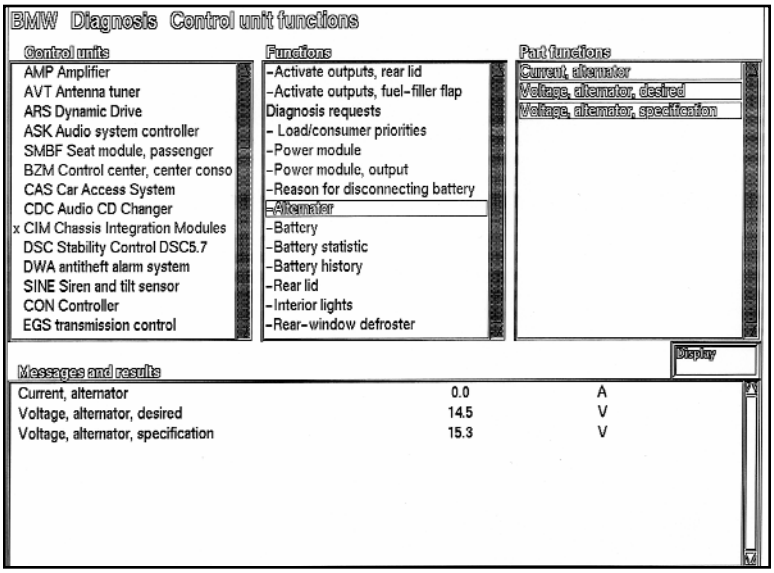


- By selecting <**Reason for disconnecting battery**>, this will display why the Power Module switched of the Electronic Battery Master Switch.

Examples of why the Power Module switched off the Electronic Battery Master Switch to disconnect the battery are:

- Excessive current was measured after switching off KL R.
- Excessively high vehicle closed-circuit current was measured.
- A short-circuit in KL 30 was detected.
- After a 3 week parking period (Stand-time limitation).
- The battery capacity (SoC) dropped below the Start limit (threatened).
- By a DISplus/GT1 diagnostic command.

- By selecting <Alternator>, this will display the charging output that the Power Module desires and receives from the Alternator.



The Power Module regulates the charge level to the battery based on:

Optimum Charging
The battery voltage can fluctuate between 14.0 V and 15.5 V. The optimum charge voltage is set according to the charge level of the battery, the battery temperature and the status of the external lights (higher charging voltage with lights off). The maximum setting is 16 V.

Temperature-Dependent Battery Charging Voltage
By using a charging characteristic map stored in the Power Module, the charge voltage of the alternator is adjusted according to the battery temperature.

The Power Module detects the temperature of the battery and places the instruction "Increase charge voltage" on the K-CAN Periphery. The CAS passes the message on to the K-CAN System bus. The ZGM receives the message. Performing its function as a "gateway control unit", it passes the message on to the PT-CAN. The ECM module receives the request to increase the charge voltage over the PT-CAN.

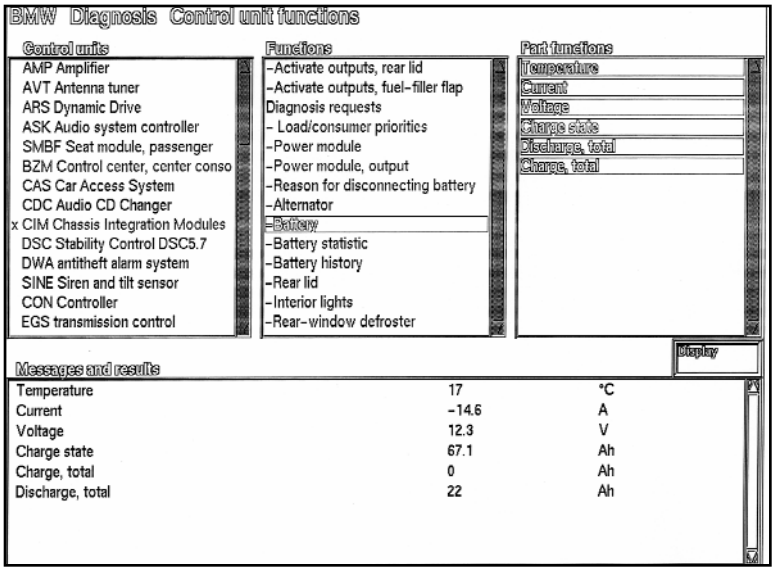
The alternator then receives the request to increase the charge voltage via the BSD lead (Bit Serial Data interface). The electronic evaluation unit in the alternator then adjusts the charge voltage accordingly. If the temperature sensor is defective then the charging voltage will be fixed at 14.3 V.

Increasing Idle Speed to Improve Battery Charging
In order to drain as little energy as possible from the battery during freezing weather (below 34°F) the engine idle speed may be increased.

This ensures that the battery charge level is kept high. If the charge level falls below the calculated minimum level for starting, the engine idle speed is increased to 750 rpm.

The calculation of the minimum level for starting takes in account the temperature and the condition/age of the battery.

- By selecting <Battery>, this will display the battery “state of health” according to the Power Module’s calculation.



The relationship of charge vs: discharge can be seen here. This is helpful for determining a sulfated battery.

Battery Charge Level Detection

The Power Module knows what the charge level of the battery is at any time by calculating the battery current when the vehicle is being driven and measuring the discharge current.

When the vehicle is not in use, the charge level is re-calculated and updated by measuring the closed circuit battery voltage. If the vehicle battery is replaced it must be registered with the Power Module so that the stored values can be deleted and a new calculation started.

Central Battery Voltage Notification

The Power Module continuously measures the battery voltage. This information is made available to all other control units via the Bus link. This can be used, for example, to enable continuous running of the sliding/tilting sunroof regardless of battery voltage.

Central battery voltage notification eliminates the need for individual measurement of battery voltage by each control module.

Data Memory

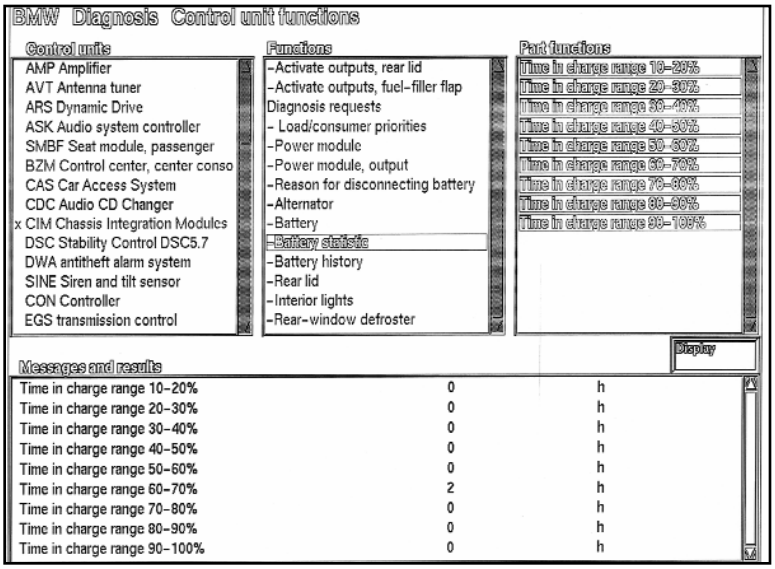
The Power Module data memory stores electrical system activity (data) relevant to the vehicle. That information provides a status read-out of the battery load and life. The data memory will be used in future to obtain a load profile of the battery in normal operation that will be analyzed for Condition Based Service.

Battery Temperature Sensor

In the event of a defective sensor, a short circuit or an implausible value, the substitute value of 20 ºC is assumed. This corresponds to a fixed charge voltage of 14.3 V at the battery.

Battery capacity (SoC) is calculated using the substitute value.

- By selecting <Battery statistic>, this will display the time the battery has spent in what “state of charge” according to the Power Module’s calculation.



The Power Module determines the battery state of charge (SoC) and the time in the SoC range which is required for:

To ensure that the car is capable of starting, the charge level (SoC) of the battery is monitored when the vehicle is at rest.

The minimum battery SoC required to ensure that the car can be started again is a calculated value.

The calculation takes into account the:

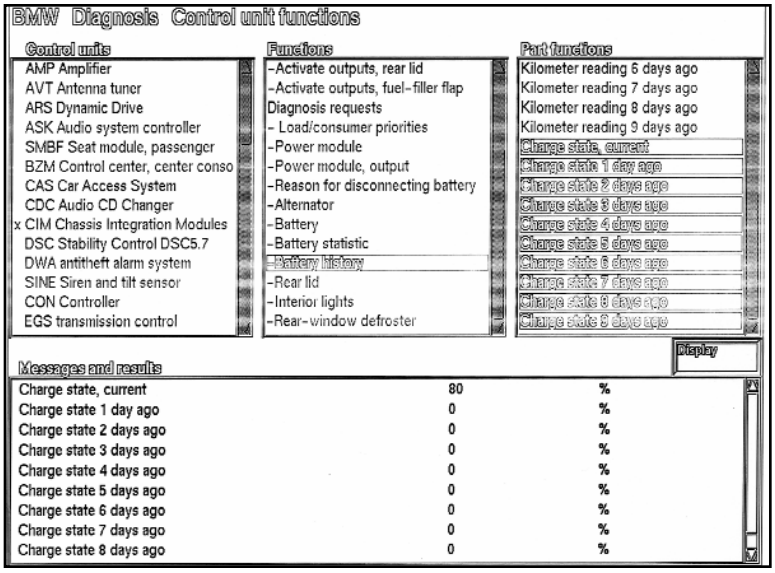
- Battery temperature measured over last few days
- Engine type
- Capacity of the battery fitted (110Ah for the 745i).

The SoC calculation is displayed as a percentage of battery capacity (A fully charged battery is considered 80%).

If the charge level of the battery gets close to that calculated minimum level as a result of the operation of an auxiliary consumer, the Power Module instructs that circuit to switch off.

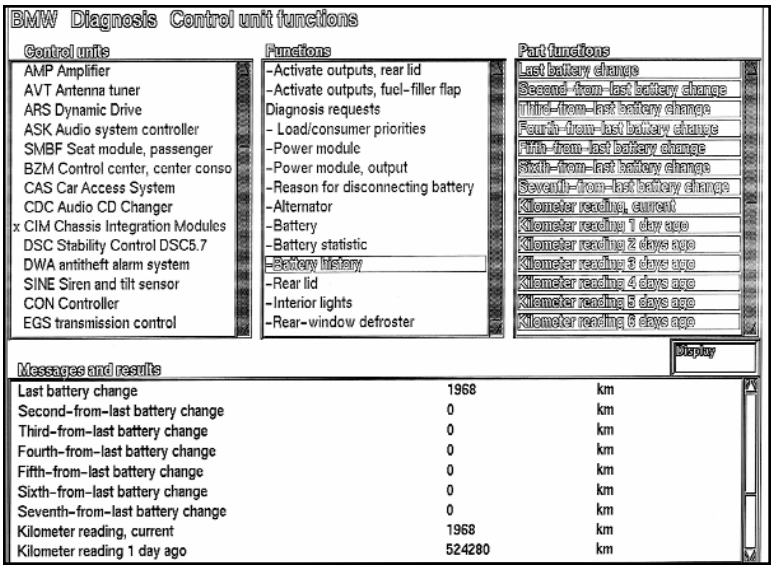
Notes:

- By selecting <Battery history>, this will display by day (up to 9 days) in what “state of charge” the battery is and was, according to the Power Module’s calculation.



In addition, the vehicle distance (in km) is displayed that is applied to the present battery.

When the battery is replaced, a reset must be registered to start this calculation as it applies to the replacement battery.



Battery Replacement Registration *(Must be performed when a battery is replaced)*

This Service Function informs the Power Module that the battery has been replaced. It completes the following operations:

- Battery capacity is set to a value that is dependent on seasonal temperature.
- The current odometer reading is stored.
- Previously stored battery statistics (current, voltage, battery charge level) are deleted.
- Previously stored temperature statistics are deleted.

When the "Register battery replacement" is requested, the state of charge (SoC) of the battery is not set to 80%, but to a value that is dependent on the seasonal temperature.

The seasonal temperature is an averaged time based value (over the last few days) for the battery SoC that is required for a successful starting procedure.

The battery SoC value is set 28% above the SoC calculated from the seasonal temperature. The following examples for the SoC after battery replacement are:

Seasonal Temperature	*SoC Value*
-25 ºC	98%
-10 ºC	68%
0 ºC	66%
10 ºC	63%
20 ºC	61%
30 ºC	58%

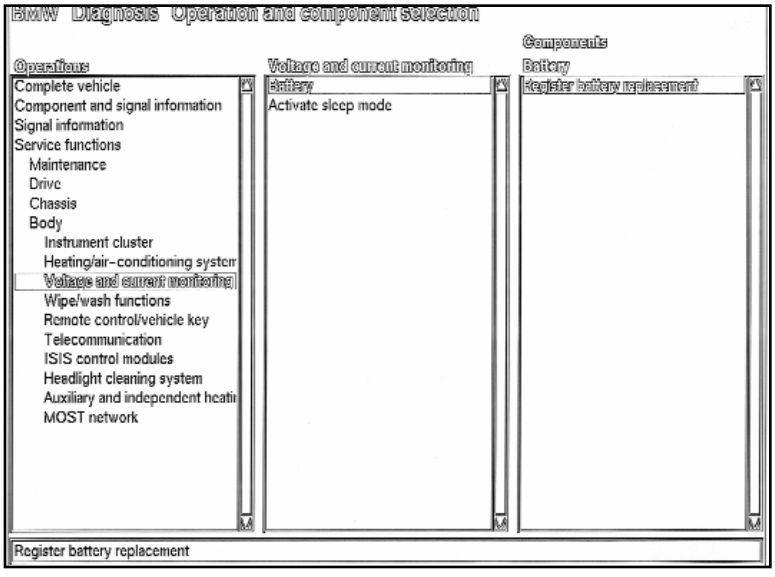
The SoC is maintained at these values until the ignition is switched “OFF” for > 2 hours. The SoC is redetermined during the closed-circuit voltage measurement (conducted after 2 hours) and then calculated based on the battery current.

Note: Central Locking, door changes (open/closed) and interior light status changes must not occur during this time because the timer will restart.

Procedure for Battery Replacement Registration

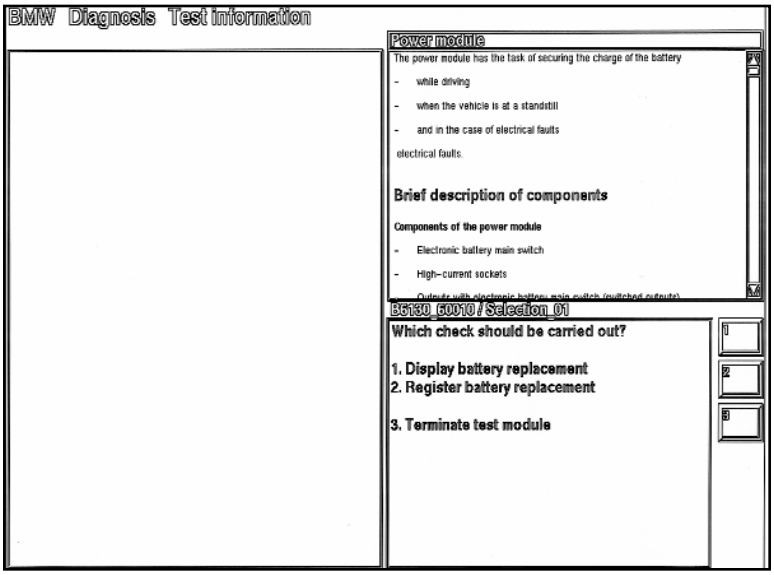
This procedure is found under: *Service Functions - Body - Voltage and current monitoring*.

- Select <Battery>, <Register battery replacement> and <Test Plan>.
- Highlight the Test Module and press the green <Arrow> to the right.



The screen prompts you to select:

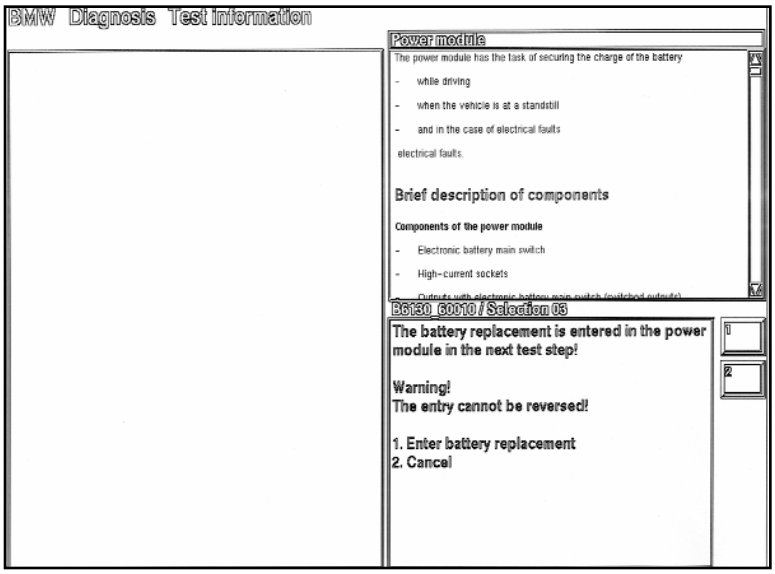
1. Display battery replacement (as described on page 29)
2. Register battery replacement
3. Terminate test module



Select #2. <Register battery replacement>, and press the green <Arrow> to the right.

This screen prompts you to:

1. Enter battery replacement
2. Cancel



Note: The battery replacement will be entered in the Power Module in the next test step.

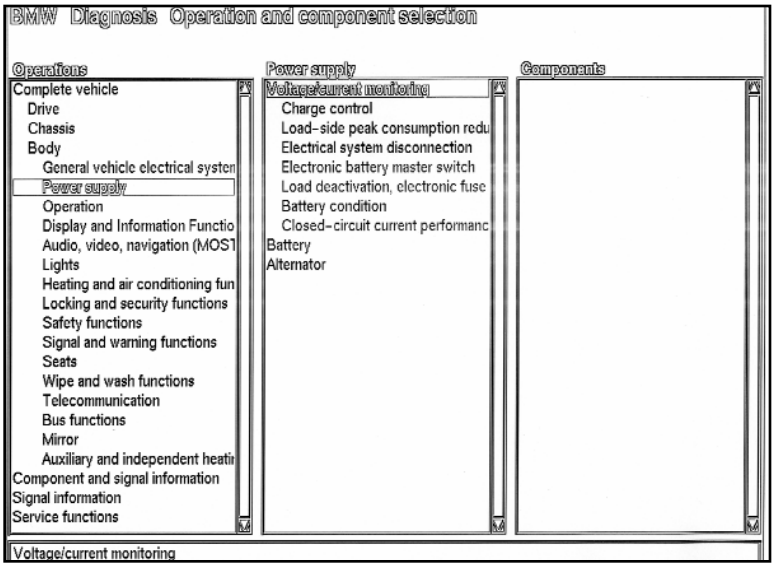
Warning! The entry cannot be reversed.

Again, this Service Function informs the Power Module that the battery has been replaced and completes the following operations:

- Battery capacity is set to a value that is dependent on seasonal temperature.
- The current odometer reading is stored.
- Previously stored battery statistics (current, voltage, battery charge level) are deleted.
- Previously stored temperature statistics are deleted.

Diagnostic Test Plans

Based on fault codes, additional diagnostic Test Plans can be found under: *Complete Vehicle - Body - Power Supply*.



Test plans are available for:

1. Voltage/current monitoring
2. Battery
3. Alternator

When you select <Voltage/current monitoring>, the Test modules (based on the status displays previously covered) available are:

Charge control - tests the Power Module's management of battery charging.

Load-side peak consumption reduction - tests the Power Module's commands and reasons to activate the prioritized shutdown of electrical consumers.

Electrical system disconnection/Electronic battery master switch - tests the Power Module's commands and reasons to reduce power consumption and disconnect excessive closed-circiut power consumers based on battery SoC and time.

Load deactivation, electronic fuse - tests the Power Module's commands and reasons to open the electronic master switch if a high short circuit current is detected.

Battery condition - tests the Power Module's interpretation of the overall battery life.

Closed-circuit current performance - tests closed-circuit current draws with additional Help Information (HI) documents showing examples of violations that prevent normal power down protocols and procedures to diagnose closed-circuit current faults.

Notes:

Review Questions

1. What information does the Power Module use to calculate the optimum charge voltage?

2. How would the driver of the vehicle know that the battery switch was in the “OFF” position?

3. What must be performed to the Power Module after replacing a battery?

4. What operations are a result of question 3?

5. During a normal Shut Down Protocol, what consumers are shut off after 60 minutes?

6. What 2 “visuals” indicate to you that the vehicle is continuing to enter sleep mode after the 16 minute period?

7. What should the final Closed-Circuit Current draw be on a “normal” vehicle?_____mA

8. What Bus circuit(s) are isolated when Fuse #15 is removed?

9. What fixed charge voltage would you expexct to measure if the Battery Temperature Sensor was defective? _____V

10. What is Special Tool #90 88 6 612 310 used for and what does it provide?